

LECTURE

Glaciations in the Midlands: some revisions of traditional views

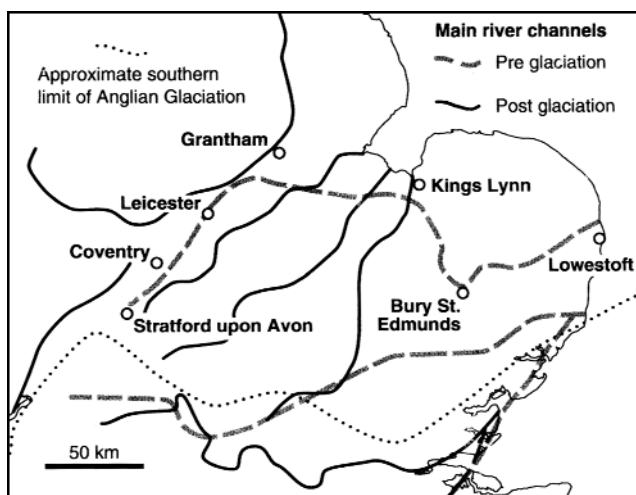
Summary of the lecture presented to the Society on Saturday 16th November 2002 by Professor David Keen of Coventry University.

The English Midlands have been an important area in research into the Quaternary from the earliest days of the Earth Sciences in the 19th century, with some of the first recognition of interglacial faunas being made by Strickland in the 1840's and the extent of local glaciation by Lloyd in the 1870's.

The first detailed model of the sequence in the region was produced by Shotton (1953), although this synthesis of the glacial and interglacial succession of the Middle and Late Pleistocene drew heavily on the mapping of the Avon terraces by Tomlinson (1925) for its timescale. The Shotton sequence recognised the units in Table 1 in the glacial sediments around Coventry.

The "pre-glacial" fluvial sequence of the Baginton Sands and Gravels was held to have been deposited in a NE flowing river that Shotton traced north of Leicester and named the "proto-Soar". The proglacial lake sediments of the Wolston/Bosworth Clay were held to have been deposited in a proglacial lake, Lake Harrison, which occupied the area between Leicester, Birmingham and the Jurassic escarpment. This lake was filled with proglacial sands ahead of the advancing Oadby Till ice which eventually over rode the lake sediments and reached a final terminus at Moreton-in-Marsh, Gloucestershire.

Overlying the Dunsmore Gravel was the terrace sequence of the Avon recognised by Tomlinson as being a staircase of terraces with the highest (Terrace 5) being the oldest and the lower terraces (4, 3, 2, 1) being recognised in descending order to the modern river. Avon Terraces 3 and 4 both



Pre- and post Anglian drainage of the Midlands (from Keen, 1999).

yielded temperate mammalian and molluscan faunas and Tomlinson and Shotton both assumed that they were from the same temperate stage although deposited after a complicated pattern of incision, aggradation, and then sculpting of the fill into the two terraces. As this cut and fill sequence was the product of one temperate episode and all the terraces post-dated the glaciation, the time available for the whole glacial and terrace succession was short and could be fitted into the late Middle and Late Pleistocene.

The revision of the sequence of terrestrial Quaternary deposits was prompted by the recognition from the 1970's of the complexity of climate change indicated by the record in the deep ocean basins compared to the simple sequences identified on land. In the Midlands the sequence was challenged first by the identification of only one chalky till glaciation from Norfolk to Warwickshire instead of the two separate glaciations previously recognised (see Rose, 1987). At first the Chalky till was thought to be relative recent perhaps in keeping with Shotton's model, but the relation of the succession to the Cromerian and Hoxnian interglacial deposits in East Anglia made it clear that the glaciation was dated to an early stage in the Middle Pleistocene.

The discovery of the Waverley Wood interglacial deposits (Shotton *et al.* 1993) interbedded with the base of the Baginton Sands and containing a mammalian and molluscan fauna of Late Cromer Complex age also strongly indicated an early date for the glaciation. Identification of the Baginton Sand and Gravel, directly underlying the glacial sequence in the Midlands, with the Ingham Sands and Gravel of East Anglia, that occupy a similar position below the type Anglian glacial deposits to the east, also unified the sequences in both areas (Rose, 1987).

The glaciation can also be dated from the overlying deposits. The terraces of the Avon were known by Tomlinson to post-date the glaciation, but the sequence in the crucial area between Evesham and Pershore as investigated by Maddy *et al.* (1991) did not show the complicated cut-and-fill sequence of Tomlinson, but a simple terrace staircase in which Avon terraces 4 and 3 occupied different rock-cut steps and were separable on the basis of molluscan biostratigraphy (Keen, 2001). As Avon Terrace 3 yielded *Hippopotamus* at a number of localities in the

Dunsmore Gravel	Outwash
Oadby Till	Chalky till from NE
Wolston/Wigston Sand	Proglacial sand
Wolston/Bosworth Clay	Proglacial lake clays
Thrussington Till	Triassic-rich from N & NW
Baginton Sand & Gravels	Proto-Soar sands & gravels

Table 1. The Shotton sequence.

stage	OIS	local deposits and events
Devensian	2	(<i>glaciation in Northern England</i>)
Ipswichian	5	Avon Terrace 3
	6	(<i>possible glaciation in Eastern England</i>)
	7	Avon Terrace 4
	8	
	9	Avon Terrace 5
	10	latest glaciation in area; Oadby Till
Hoxnian	11	
Anglian	12	Thrussington Till
Cromerian	≥13	Baginton Sands and Gravels

Table 2. Possible correlations between the oxygen isotope stratigraphy of the oceans and key Middle and Late Pleistocene events in the Midlands.

lower Avon it is clear that it must have been deposited in the Ipswichian interglacial, the only phase in the Middle and Late Pleistocene when this animal was present in Britain. The older Avon Terrace 4 has yielded a mammoth/*Corbicula fluminalis* fauna typical of numerous sites across southern Britain which have been dated to Oxygen Isotope Stage 7. Deposits other than river terraces are rarely found resting on the glacial deposits, but at Frog Hall east of Coventry sediments have yielded pollen and amino-acid ratios indicating an age in the Hoxnian Interglacial, either OIS 9 or 11 (Keen *et al.* 1997).

Although the succession, age relationships and distribution of the major units of the Quaternary in the Midlands have remained unchanged since the early years of the 20th century, modern views of the timescale involved in their deposition suggest their formation over perhaps twice the time thought necessary by Shotton and Tomlinson (Keen, 1999). The continuity of the Baginton Sands and gravels with the Ingham Sands and Gravels suggests deposition in a major west-east flowing river which dominated the drainage of the Midlands in “pre-glacial” times. The occurrence in these deposits at Waverley Wood of stone tools indicates the importance of this succession for the early human settlement of Britain. The glaciation, with two ice advances, separated by a non-glacial episode of lacustrine and deltaic deposition is still not well



Sediments of Avon Terrace 3 at Eckington.

known in terms of its age or the timing of the ice advances. The conventional view (see Keen, 1999 for discussion) is that both the Thrussington and Oadby tills belong to the same cold stage (OIS 12) on the basis of the intensity of cold of that episode in the oceanic record and on the dating of the later deposits resting on the tills. However, no fully acceptable means of dating has been applied to the sequence and Sumbler (2001) has proposed that the two ice advances may be the product of separate glacial stages in OIS 12 and 10. Certainly, so far no fluvial deposits of the “new” rivers draining to the Wash and the reversed Avon, which replaced the “proto-Soar/Ingham River” older than OIS 9 have been found resting on the glacial succession, perhaps suggesting an OIS 10 age for the latest glaciation of the area. This date is also suggested by the ages of the river terraces of the “new” rivers which developed on the Anglian glacial deposits after the ice retreated and replaced the Ingham River with a SW flowing river (now the Warwick/Worcestershire Avon) and three major rivers (the Welland, Nene and Great Ouse) flowing to the Wash replacing the eastern extent of the Ingham River. None of these rivers has a terrace that can be dated as being older than OIS 9, thus suggesting that these “new” rivers began their evolution after an OIS 10 ice retreat. The development of terraces in each temperate stage after OIS 9 provides the necessity of a long time span between the end of the glaciation and the present. This is unlike the model of the workers in the mid-20th century, but is more in keeping with modern views on the pattern of Pleistocene climatic change.

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